

What is claimed is:

CLAIMS:

1. A method of transferring an image, including 0th diffraction order and $\pm 1^{\text{st}}$ diffraction orders, onto a material, said method comprising the steps of:

fabricating a phase-shifting mask comprising at least one unattenuated, halftoned, phase-shift feature; and

5 off-axis illuminating said mask such that radiation traverses said mask and impinges on said material.

2. A method of transferring an image, including 0th diffraction order and $\pm 1^{\text{st}}$ diffraction orders, onto a material, said method comprising the steps of:

10 fabricating a phase-shifting mask comprising at least one feature, wherein said at least one feature includes halftoned, phase-shifted, transparent features; and

off-axis illuminating said mask such that radiation passes through said mask onto said material.

3. A method of Claim 2, wherein said at least one feature further includes semi-transparent features.

15 4. A method of Claim 2, wherein said at least one feature further includes opaque features.

5. A phase-shifting mask comprising at least two unattenuated, halftoned, phase-shift features having a width w , said features separated by a width substantially equal to w ,

20 wherein said mask provides an image including 0th diffraction order and $\pm 1^{\text{st}}$ diffraction orders, when illuminated.

6. A phase-shifting mask comprising at least two halftoned, phase-shifted, transparent features having a width w , said features separated by a width substantially equal to w ,

5 wherein said mask provides an image including 0^{th} diffraction order and $\pm 1^{\text{st}}$ diffraction orders, when illuminated.

7. The phase-shift mask of Claim 6, wherein said at least two features further include semi-transparent features.

8. The phase-shift mask of Claim 6, wherein said at least two features further include opaque features.

10 9. The phase-shift mask of Claim 5, wherein a focus-exposure process window for maintaining a predetermined resist line-width sizing of said mask is substantially common to an attenuated, phase-shift mask of a similar pitch.

10. The phase-shift mask of Claim 6, wherein a focus-exposure process window for maintaining a predetermined resist line-width sizing of said mask is substantially common
15 to an attenuated, phase-shift mask of a similar pitch.

11. A device manufacturing method comprising the steps of:

(a) providing a substrate that is at least partially covered by a layer of radiation-sensitive material;

(b) providing a projection beam of radiation using a radiation system;

20 (c) using a pattern on a mask to endow the projection beam with a pattern in its cross-section;

(d) projecting the patterned beam of radiation onto a target portion of the layer of radiation-sensitive material,

wherein, in step (c):

- use is made of a phase-shifting mask comprising at least one unattenuated, halftoned,
25 phase-shift feature;

- the mask is off-axis illuminated by the radiation system.

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A device manufacturing method comprising the steps of:

- (a) providing a substrate that is at least partially covered by a layer of radiation-sensitive material;
- (b) providing a projection beam of radiation using a radiation system;
- 5 (c) using a pattern on a mask to endow the projection beam with a pattern in its cross-section;
- (d) projecting the patterned beam of radiation onto a target portion of the layer of radiation-sensitive material,

wherein, in step (c):

- use is made of a phase-shifting mask comprising at least one feature, wherein said at
- 10 least one feature includes halftoned, phase-shifted, transparent features; and
- the mask is off-axis illuminated by the radiation system.

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A device manufactured using a method according to claim ¹~~11~~.

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A device manufactured using a method according to claim ³~~12~~.